Analysis of Probability Density Function By Programmed Electrical Stimulation

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A detailed analysis of the ability of Probability Density Function (PDF) to differentiate between ventricular dysrhythmias and sinus tachycardias has not been conducted. We evaluated PDF in 18 pts undergoing Automatic Implantable Cardioverter Defibrillator (AICD) placement. During predischarge Programmed Stimulation, each pt was atrially paced 5 bpm below the AICD rate cut off to ensure double counting did not occur.The pt was then paced at a rate 5 bpm above the rate cut off to determine the ability of PDF to properly identify a "SVT". Six pts were eliminated, 3 for double counting and 3 for AV block with atrial pacing. In one case, a pt developed left bundle branch block with atrial pacing leading to AICD charging and was excluded from the study.

Six of the remaining 11 pts (55%) with narrow complexes during rapid atrial pacing experienced inappropriate AICD charging. Shocks were diverted by magnet. This study demonstrates that PDF may have a limited role in preventing inappropriate AICD discharges secondary to narrow QRS complex tachycardias above the AICD detection rate.

USE OF THE SIGNAL AVERAGED ECG TO PREDICT NEED FOR THE AUTOMATIC IMPLANTABLE CARDIOVERTER-DEFIBRILLATOR

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To assess the role of the signal averaged electrocardiogram (SAECG) in predicting need for an automatic implantable cardioverter-defibrillator (AICD), we retrospectively compared the clinical characteristics and SAECGs of 34 pts who had AICDs for ventricular fibrillation (VF) or tachycardia (VT) and who either received (S, 17 pts) or never received (NoS, 17 pts) an appropriate AICD shock. Shocks were excluded if there was documentation of a rhythm other than VF or VT at the time of shock. All other shocks were deemed appropriate. The SAECG was classified as abnormal if the filtered QRS duration was >120 ms, root-mean square voltage of the last 40 ms of the QRS <20 mcV, and the duration of low amplitude signals (LAS) >38 ms, and indeterminate if the QRS on the surface ECG was >110 ms. The S and NoS pts had similar follow-up times (592 vs 674 d, respectively, p=0.49), age (59 vs 57 yrs, p=0.58), gender (82% vs 77% male, p=0.67), underlying disease (coronary disease in 76% S and 71% NoS pts, p=0.60), number arrests pre AICD (1.2 vs 1.3, p=0.94), and inducibility (82% vs 64%, p=0.40). S pts had lower ejection fractions (0.25 vs 0.38, p=0.01), a greater number of drug exposures pre AICD (4.2 vs 2.7, p=0.01), and a different spectrum of rhythm diagnoses (VF, VT, or both in 29%, 53%, and 18% in S and 65%, 0%, and 35% in NoS pts, respectively, p=0.02). Normal, abnormal and indeterminate SAECGs were obtained in 18%, 23%, and 59% of the S pts and 24%, 35%, and 41% of the NoS pts, respectively (p=0.59). At 2 yr follow-up, AICD use was 57%, 40%, and 59% of pts with normal, abnormal, and indeterminate SAECGs (p=0.62). Thus, 1) in a high risk population for cardiac arrest, the SAECG was clearly normal or abnormal by standard criteria in only 50% of pts, 2) a normal SAECG does not preclude that an AICD will be appropriately used, and 3) conversely, an abnormal SAECG does not necessarily predict future AICD use.

ELECTRONIC IDENTIFICATION OF VENTRICULAR FIBRILLATION WAVEFORM TYPE SUSCEPTIBLE TO DEFIBRILLATION USING LOW ENERGY SHOCK

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Low energy DC shocks (DCS) are often observed to successfully defibrillate at one attempt but not at another, even when energy, and duration of ventricular fibrillation (VF) are kept constant. To ascertain whether the type of VF waveform can determine success or failure, a fixed capacitor discharge with 50% success rate was used in an open-chested canine VF model (7 dogs). VF was induced with identical AC current and after 10 secs a truncated exponential shock was delivered through a pair of patches sutured on the heart. Patch size and location, discharge voltage and duration of VF were kept constant. Shocks with similar transmyocardial impedance (TMI) and energy were compared. Lead II VF waveform was digitized and the mean absolute integration of VF voltage (AIVF) were examined for each successful as well as unsuccessful DCS. The AIVF is defined to be the absolute digital integration of one second of VF waveform voltage prior to the DCS.

(Results)±SEM	TMI(ohms)	Energy(joules)	AIVF(mV)
Successful DCS	72.6±1.2	4.38±0.9	0.80±0.08
Unsuccessful DCS	72.6±1.2	4.38±0.9	1.00±0.15
P value	NS	NS	<0.02

Conclusion: Successful defibrillation appears to be associated with VF waveforms generating a low AIVF. Of note, a low AIVF waveform has the morphology approaching ventricular tachycardia waveform. These findings suggest that it may be electronically possible to identify VF waveforms more susceptible to DC countershock with potential application in implantable device.

Wednesday, March 21, 1990
2:00PM–3:30PM, Room 36
Electrophysiology of the Conduction System

EVIDENCE SUGGESTING TIME DEPENDENT RECOVERY IN THE SINUS NODE IN MAN.

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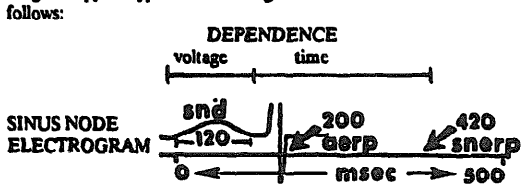
Microelectrode recordings have revealed a time as well as voltage dependence for the recovery of excitability in the sinus node (SN). We hypothesized that similar mechanisms are operative in man. Since direct SN stimulation by programmed techniques cannot be verified in man, we utilized an indirect approach to assess the human sinus node functional properties. The voltage course was determined by the duration of SN depolarization (SND), ie. the time spent away from the isoelectric baseline on a direct SN electrogram. The time dependence of recovery was determined by SN refractoriness, i.e. the SN effective refractory period (ERP). Using the APD (A1A2) technique, SNERP could only be assessed when it exceeded atrial ERP (AERP). As previously published by several groups, the onset of atrial interpolation was used to define SNERP. If SNERP exceeded SND and was not limited by AERP, a time dependence of recovery would be suggested. All patients studied had normal SN function on surface ECG or during electrophysiologic testing and none was on drug therapy. A typical SN electrogram and indications of ERP durations follows:



In 8/8 patients studied the SNERP exceeded both AERP and SND. Also, the group(mean/SD) SNERP(312±70ms) exceeded both AERP(186±17ms) p<.002 and SND(107±11ms) p<.002. These results suggest the presence of time dependence in the human sinus node.

CONCLUSION: These indirect measurements provide evidence for a time dependent recovery of excitability in the human sinus node.